REMARKS/ARGUMENTS

Reconsideration and allowance of the above-referenced application are respectfully requested.

Claims 1-18 are pending. Claims 1-18 are rejected under 35 USC 103(a) as being unpatentable over Schwab et al, US Patent No. 6,271,430, in view of admitted prior art. The Office Action asserts that the differences between Schwab and the claims of the present application are that (1) Schwab does not disclose the recovery of isobutylene after the autometathesis reaction, and (2) Schwab does not disclose the ratio of external fresh ethylene to the n-butenes in the C_4 olefin stream. The Office Action then alleges that it would have been obvious to modify the Schwab process by removing the isobutylene from the autometathesis process before recycling recovered butenes. The Office Action further asserts that it is obvious to modify Schwab by selecting the appropriate amount of ethylene feed to the second metathesis reaction. The applicant respectfully disagrees.

Schwab '430 is directed to the processing of a C4 olefin stream from which the majority of the isobutylene already has been removed. The stream is referred to as a "raffinate II" (col 2 lines 62-65 and independent claim 1), which is defined in industry as a stream **after** isobutylene (isobutene) removal. In column 3, lines 1-2, Schwab indicates that the raffinate II can comprise "at most 1-2% by weight isobutene". It is the object of the present invention to produce propylene when the isobutene content of the feed is high (**before** isobutene removal). The isobutene content in the example included in the application is 18.64%.

The autometathesis step disclosed by Schwab is the reaction between 1 butene and 2 butene to form propylene and 2 pentene. In addition some other heavies are formed including 3 hexene. The C5 and heavier materials are defined as "high boilers". The effluent from the metathesis step is sent to a fractionation column where C2 and

C3 are removed, a C4 stream is removed and recycled to the autometathesis reactor 1 and the C5 and heavier fraction is sent to reactor 2 where it is combined with ethylene (fresh and recycle) under metathesis conditions to produce propylene and C4's. This scheme can be represented chemically as follows:

Autometathesis reactor 1

1. 1 butene + 2 butene → propylene + 2 pentene
2. 1 butene + 1 butene → ethylene + 3 hexene

Metathesis reactor 2

3. Ethylene + 2 pentene → propylene + 1 butene
4. Ethylene + 3 hexene → 1 butene + 1 butene

As can be seen:

- Reaction 2 and Reaction 4 are simply reverse reactions.
- Reaction 1 and Reaction 3 can be combined to form a reaction 5

~~1 butene~~ + 2 butene → propylene + ~~2 pentene~~

Ethylene + ~~2 pentene~~ → propylene + ~~1 butene~~

5. Ethylene + 2 butene → propylene + propylene

Reaction 5 is the "conventional" metathesis reaction well known in the industry for the production of propylene. Schwab has simply created a process that separates a single reactor system into a two reactor system to accomplish what is done by adding ethylene to a mixed 1 butene / 2 butene raffinate II stream over a physical combination of a metathesis catalyst and a double bond isomerization catalyst.

Reaction 4 is the reverse of reaction 2 and is used to effectively recycle the C5 produced by reaction 1.

The process disclosed in the present application is substantially different from that of Schwab because in the presently claimed method, the feedstock C4 olefin stream can contain high amounts of isobutylene. It is the intention for the isobutylene to participate in the reaction. Schwab does not anticipate this nor disclose the participation of isobutylene in the reaction. By using "raffinate II" it is evident that Schwab calls for the removal of isobutylene upstream from the process disclosed in the '430 patent.

The invention specifically promotes reactions 2, 3, 6 and 7 in the reaction table below. In the autometathesis reactor 1 of the invention, reactions 2 and 3 take place (as disclosed in Schwab) but also the isobutylene reacts with both 1 and 2 butene via reactions 6 and 7 to form ethylene and propylene and iso C5 and C6 components.

The product from the autometathesis reaction is fractionated into a C2/C3 stream, a C5 and heavier stream and a C4 stream.

Unlike Schwab, the C5 and heavier stream is NOT reacted with ethylene but is used as a product. The iso C5 and C6 components created by the reactions 6 and 7 involving isobutylene make this stream valuable as a gasoline blending stock. With the feedstocks of Schwab (raffinate II), this stream would have considerably less value.

Reaction
1 2-butene + ethylene → 2 propylenes (conventional metathesis) (fully productive)
2 1-butene + 2-butene → propylene + 2-pentene (fully productive)
3 1-butene + 1-butene → ethylene + 3-hexene (half productive)
4 isobutylene + ethylene → no reaction
5 1-butene + ethylene → no reaction
6 isobutylene + 2-butene → propylene + 2-methyl 2-butene (fully productive)
7 isobutylene + 1-butene → ethylene + 2-methyl 2-pentene (half productive)

The C4 stream from the fractionator of the present invention is NOT recycled to the autometathesis reactor as per Schwab, but sent to another fractionation specifically to remove the unreacted isobutylene. In the first autometathesis reactor approximately 60% of the isobutylene has been reacted away via reactions 6 and 7. These reactions produce ethylene and propylene at high efficiency (in terms of n butene selectivity) as described in the application. The unreacted isobutylene is removed from the C4 stream and the remaining 1 butene and 2 butene are reacted with ethylene in the second reactor. This produces propylene at the highest efficiency via the reaction

Ethylene + 2 butene → propylene + propylene

	Schwab	Invention
C4 feed	Low isobutylene	High isobutylene
Reactor 1	Autometathesis (reactions 2 and 3)	Autometathesis (reactions 2,3 6, and 7)
Fractionation	C4 stream recycle to autometathesis C5 and heavier to reaction with ethylene	C4 stream to isobutylene removal and n butenes react with ethylene C5 and heavier stream as a gasoline product
Reactor 2 (with ethylene)	C5/C6 olefins to form propylene and feed butenes for recycle to reactor 1	Normal C4 olefins to form propylene for product
Isobutylene Removal	All isobutylene removed upstream of process (to 1-2% level).	Removal after reaction results in smaller tower since 60%+ has been reacted away.

An additional advantage of the process of the invention is the reduction in the size of the equipment for isobutylene removal. The process sequence :

- Uses isobutylene in reactor 1 to achieve high efficiency propylene production from normal butenes
- Produces a valuable product from the C5/C6 stream as iso components valued for gasoline
- Reduces the size of isobutylene removal equipment saving capital and energy.

The above is not possible with the process disclosed by Schwab. Reconsideration is requested.

An Information Disclosure Statement is submitted herewith, along with formal drawings.

A telephone interview is respectfully requested at the number listed below prior to any further Office Action, i.e., if the Examiner has any remaining questions or issues to address after this paper.

In view of the above, it is believed that this application is in condition for allowance, and such a Notice is respectfully solicited.

Respectfully submitted,

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